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Agricultural Education

BY

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Whilst vocational training in all its branches is receiving the attention of educationists, both out of, and in Government service, a very important part of it, *viz.*, Agricultural training, has not received the notice it deserves. Almost every day one comes across the statement both in the daily papers and in the various economic journals that Agriculture is the paramount industry of India. The very obviousness of it, perhaps, results in that very few pay any further attention to the matter than a cursory 'of course'. To the ordinary layman Agriculture means little more than using the plough and trusting to luck for a good crop, and many people are surprised when they are told that Agriculture is as much a Science as, say, Engineering, and involves the intelligent use of many scientific laws. Further, there exists in the minds of certain people a feeling half-contemptuous and half-pitiful that Agriculture is a calling not worthy of a gentleman and this sort of a hostile atmosphere scares away many an intelligent lad from what is after all, a healthy, honourable and independent profession which yields quite a comfortable living to its devotees.

It may be as well to indicate here briefly, the scope of Agriculture

so that those who have not yet determined what profession to follow might be assisted to some extent in the choice of their future careers. This seems all the more necessary since it is commonly found that young men seek admission to every professional institution they can think of, and join that where they can get admission and what is more important a scholarship, without in the least bestowing any attention on their likes and dislikes, their aptitude and the probable course of their future lives.

Agriculture, while it is concerned with the raising of the various crops, also includes the marketing both of the raw and manufactured products. A bald statement like that may not convey the importance of the subject, but when it is realized that man's food and clothing, many medicines and raw materials for manufactures are obtained from Agriculture, its importance at once becomes apparent. In recent times the Science of Agriculture has outgrown its old limits and has become so extensive that it has been found necessary to cut it up into various branches, such as Agronomy, Horticulture, Animal Husbandry, Forestry, etc., and even these are further subdivided so that we now have subdivisions in Agriculture more or less clearly defined, such as Agronomy, Pomology, Floriculture, Soil Technology, Soil Physics, Agricultural Bacteriology, Agricultural Chemistry, Agricultural Botany, Agricultural Engineering, Mycology, Entomology, Sericulture, Dairying, etc. The process of division into narrower and more homogeneous groups has gone further still, leading to specialization in very restricted fields of Agriculture. Such specialization has yielded some wonderful results which would not have been possible if such detailed attention had not been paid. To quote Dr. Russell, "Perhaps the most striking feature of the past ten years' developments has been the increasing recognition of the complexity of Soil Phenomena." "It is not sufficiently recognized, however, that this complexity necessitates a difference in method of investigation from that usually adopted in scientific laboratories. A chemist dealing with a single substance can treat it in a certain way, and be reasonably certain that the result obtained is the direct consequence of the treatment. The soil investigator has no such certainty; definite treatment of a soil may be followed by a definite result, but there may be no direct relationship with the factor under investigation—the result may

be merely a reflex of some far-reaching change produced in some other factor which is entirely overlooked. Further, if observations are attempted in the field it is impossible to ensure such simple variation as the recorded data seem to suggest." "Just as the ordinary methods of investigation are insufficient, so also the customary divisions of science cannot be rigidly maintained in soil work. The chemist is constantly confronted with physical and biological problems : the biologist constantly needs the help of the statistician, the physiologist and the chemist : most of the work is essentially 'team-work' requiring the close co-operation between experts in different branches of Science." "A body of workers by harmonious co-operation is able to make advances that would be impossible for any single individual, however brilliant." When it is added that most of the progress of modern Agriculture in the West has been the result of such research work, it will at once be realized what a useful and fascinating subject Agriculture really is.

Facilities for education in Agriculture are available in various parts of India in the various Agricultural Colleges. An Agricultural institution having been found necessary for the students of the Mysore State, it was established in 1913, on the Central Experimental Farm of the State, at Hebbal near Bangalore, and has been running ever since. For the first few years, it attracted a fair number of students, but recently the number has fallen off owing to various reasons, one of them being that the school being out of Bangalore, is not perhaps known so well as the other technical schools are known. When the institution was first started, it began with a two years' course at the end of which diplomas were given to the successful candidates. Latterly it was found that two years were not enough for a thorough training, and a three years' course was instituted in 1920. As the course is at present constituted, instruction is given in the following subjects :—Soil Science, Physics, Chemistry (organic and inorganic), Botany, Zoology, Agricultural Engineering, Agricultural Chemistry, Veterinary Science, Live Stock, Dairying, Irrigation and Drainage, Agronomy, Mycology, Entomology and Agricultural Economics. These subjects are taken by the officers of the respective sections of the Agricultural Department.

It has often been questioned if a study of so many subjects is necessary for an agriculturist, although it must be obvious that

a thorough knowledge of the why and wherefore of things will naturally lead to a more workmanlike job than would otherwise be the case. Although most Agricultural practices are reduced to mere rule of thumb by the accumulation of the experience of generations, still it must be conceded that an appreciation of the rationale of any operation will result in that operation being more efficiently done. Taking as an example the manuring of ragi fields, the usual practice one meets with is the dumping of manure on the fields in heaps and letting it stay there till the land is ploughed. It has been found by experience that manure has to be given to the fields, and manure is given without a thought spent on what happens to the manure if it is left on the fields in heaps and that when rains are expected. Agricultural Chemistry teaches us that a certain amount of important plant foods is lost when manure is left in heaps in the open, exposed to rain, and as a result of this knowledge, one who knows will get the manure spread soon after it is carted on to the field and thus saves all the plant foods that would otherwise be lost. Similarly with the other branches of Agriculture. Soil science teaches us what operations should be done on the land and when and how exactly they should be done. Agronomy teaches us what crops to grow on any soil, when and how to grow them, and how to improve them ; Agricultural Chemistry teaches us all about the manuring of fields and the feeding of animals. Live stock teaches us the best ways of breeding and looking after the animals both for dairy and other purposes, and teaches us everything connected with Dairying ; Agricultural Engineering helps the farmer who has to lay out his farm, open up drains, put up buildings, fences, roads, etc. ; Mycology and Entomology teach us the best methods of combating pests and diseases of crops ; Botany tells us how exactly plants live, what they require for their proper nutrition, and Agricultural Economics makes clear the relations existing between the producer and consumer and shows the farmer how to conduct the business as a business. This very cursory survey shows clearly the necessity of all the subjects taught in the Agricultural school, for the modern farmer.

The Mysore Agricultural School is situated on the Bangalore-Chickballapur Road, about five miles from Bangalore. It is close to the road and on the side opposite to that on which the village stands, and on the slope of the catchment of the Hebbal tank, thus

making the location both easily accessible and very healthy. Facilities exist for various outdoor games, such as cricket, hockey, football, tennis and a qualified medical officer visits the students twice a week and looks after their health. A hostel and other necessary institutions are maintained and it is a rule that all students must be members of the hostel. A library is attached to the school, where some of the best and latest books and magazines on Agriculture are kept for the use of students. No fees are charged for tuition and a number of scholarships are provided both by Government and various District Boards.

With the Government affording so many facilities for agricultural education in the State, it is discouraging to find that they are not availed of as much as they ought to be. It is in the hope that those whose eyes will catch this article, will, if they do not already do so, take active interest in the future of Agriculture in Mysore and help in creating an interest in the agricultural school in the minds of landowners in the State so that this school might be better known throughout the State and that all those who would profit by a course of study here, might have a chance of undergoing such a course, that this article is written and I sincerely believe that this hope will be realized.

The Manufacture of Ensilage

BY

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The preservation of grain and fodder in air-tight pits is nearly as old as history itself, and dates back to early Persian and Roman times, but only in the last century has this method of conserving green fodder become general. In Europe this system has certainly been known to, and practised by agriculturists for a century. The first silo was built in the United States in 1876, though to France goes the honour of the first silo ever constructed above ground. Since that time the value of the silo has become more and more appreciated, until at the present day, in Canada and the United States more particularly, the silo has come to be considered as important a part of the farm equipment as the cattle themselves. In India,

however, the use of the silo as a means of preserving fodder has not extended much beyond the Military and Government Farms, and it is the purpose of this article to endeavour to point out the value of ensilage, and to briefly outline the methods of its preparation. Many have expressed doubts to the writer as to the possibility and utility of making ensilage in Mysore. Such suggestions as the necessity for educating cattle up to the habit of eating ensilage have also been made. However, after making over 500 tons of ensilage in various places, in different pits and towers, and of several crops, during the last two years, and after feeding this to cattle of various kinds, as well as sheep, the results have been such as to force upon one the necessity of giving wider publication to the silo in Mysore, than it has received hitherto.

In fact, the silo seems to be particularly suitable to Mysore, especially in Malnad tracts. There, hundreds of tons of good grass are allowed to go to waste annually. At the time of its growth the cattle live in a land of plenty, but are unable to consume more than a small fraction of the grass available. On account of the frequency of rains at this time, it is difficult and sometimes impossible to convert this into hay. Consequently this valuable feed is allowed to become dry and fibrous on the ground and loses its value for feeding purposes, and becomes in fact of no use, except for starting forest fires, if such can be termed a use. This waste could be very much lessened by a general use of silo pits and an enormous amount of feed saved which is now allowed to become entirely useless. The following analysis of grass ensilage made at Marthur Farm (Shimoga District), which receives an annual rainfall of over 100 inches, compares very favourably with maize silage made in the United States.

	Water	Ash	Crude protein	Fibre	Carbo hydrate
Grass silage					
Marthur Farm. ..	59·9	2·67	2·12	16·9	20·38
Maize silage, U.S.A. (average of 99 samples)	73·6	2·1	2·7	7·8	13·8

From this it is seen that grass ensilage, made under Malnad conditions is only slightly lower in protein, and is considerably higher in carbohydrates than maize silage, which is the best kind of silage made in the United States. And the opportunity to make hundreds

of tons of it yearly is being totally disregarded in Mysore at the present time. In the Maidan area, there is also ample opportunity for the manufacture of ensilage. Large quantities of grass are available for this purpose in forest plantations, on the edges and bunds of wet lands, and similar places, the sum total of which would run in large amounts if compiled. As in the Malnad, a great proportion of this kind is improperly or not at all used before its value has been much depreciated. The silo presents itself as a remedy for this state of affairs. It is only necessary to hint at the benefits to cattle of a hot weather supply of feed such as the silo would provide, for the least imaginative to realize the necessity of developing this practice if the live stock situation is to be handled in a satisfactory manner under present conditions.

The Advantages of the Silo.

1. It is an easy and quick way of preserving green fodder in any kind of weather.
2. The ensilage, if properly made, will keep indefinitely.
3. The fodder retains its juices, and consequently loses less weight than if dried.
4. Ensilage is an excellent substitute for grass in the hot weather, and has a laxative influence on the bowels, and gives a higher milk yield than when dry fodder is fed.
5. It is palatable to and readily eaten by all class of stock.
6. The silo provides a better method of curing such crops as jola, maize and cowpea than the ordinary method of drying it, and causes less waste when fed.

The Construction of the Silo.

In Western countries the usual practice is to build a silo above ground, which as a rule takes the form of a cylinder, from 20 to 30 feet high, and from 8 to 15 or 20 feet in diameter according to the amount of silage required. The advantages of such a structure are primarily the height which gives increased pressure and reduces the amount of packing required, the ease with which the silage is removed, and insurance against percolation water. To the Indian agriculturist the cost of constructing masonry or wooden silos above ground is prohibitive, nor do the results obtained justify the expense in this country where climatic conditions permit of pit ensilage being made

with complete success. In France, masonry trench silos are used for ensiling beet pulp and similar material. These are usually about six feet wide, by six feet deep, the length varying with the requirements of the farm. Other and cheaper silos can be made by simply excavating pits of various dimensions, and such silos are giving satisfaction on the Hebbal, Marthur and Rayankere Farms, as well as in several private estates in the Malnad. Two forms of pits have been used, and both have given satisfaction. One kind of pit used is the circular deep pit, about 10-12 feet in diameter, the depth varying from 15 to 30 feet. This kind of pit is useful in high land where there is no danger from seepage water, and where the soil is deep and no rocks are encountered. The advantage of such a pit is the depth, which makes it possible for most of the ensilage to be packed by the weight of that above it. This makes the manufacture of the ensilage easier, and also increases the holding capacity by compressing the material into a smaller space. The disadvantages of such a pit are the danger of seepage water damaging the ensilage, when the water table rises, the difficulty of original excavation, (which of course becomes too expensive to be considered when rock is encountered) and the difficulty involved in removing the ensilage for feeding purposes from a depth. This latter factor however is not of very real consequence, as the inconvenience is not a very serious one.

The other kind of below ground silo used with success is the trench silo. The dimensions of such a trench may vary considerably but the depth should be about 5 feet, or deeper. A trench shallower than 5 feet would be difficult to pack properly, and lead to excessive wastage. The width and length are entirely dependent upon the amount of material to be ensiled, as well as the number of cattle to be fed daily. The advantages of such a trench silo are the easier original excavation and removal of contents for use, but often a trench in preference to a deep pit, is a matter of necessity on account of bad drainage, or a rocky subsoil. In filling a trench silo, more care must be exercised in packing the material properly as no static pressure is obtained on account of the small depth. On the other hand this packing can be done fairly easily by driving cattle and carts over the mass, which is a matter of impossibility in the deep silo. The question as to which form of silo pit is the best is to some

extent governed by local conditions, but there are other factors to be taken into consideration which are enumerated below. In passing on to these, however, attention may be drawn to the fact that an old well which is dry, or some similar excavation can often be turned to good account as a silo. At the Rayankere (Palace) Farm, an old well and also a disused saw-pit, were both used last year with good results, and much labour saved in consequence. In such a case the decision as to which shape to adopt is decided by the facilities at hand.

In determining the dimensions of the silo pit it must be borne in mind that, as far as possible, the smallest amount of outside surface should be presented, as a certain amount of deterioration is bound to take place along the walls, bottom and top of the pit. A cube or cylinder is the best shape on this account though not always practicable. The actual cubic content of the silo will, of course, be governed by the amount of material available for preservation, and a table giving approximately the dimensions required for varying amounts is given at the end of this article. There is one other consideration however, and that is the amount of material to be fed daily, which is dependent upon the number of cattle which are to receive the benefit of the contents of the silo. This is important, as it is not advisable to expose more silage to the air than is necessary during the period during which the silage is being fed. The exposed portion should be removed daily, and the area so exposed should be of such a size that material to a depth of at least six inches will be removed from it daily. This prevents it from becoming dry, and later mouldy, and no loss of weight or palatability is sustained. Roughly speaking, a round silo 10 feet in diameter will feed 15 cattle a day without spoilage. For purposes of calculation a surface area of 5 square feet per animal may be allowed. In a trench silo a larger area would be safe as the material is not so tightly packed, and consequently occupies more space.

If conditions will allow it, a cylindrical deep pit may be regarded as the most satisfactory form of silo pit, chiefly because the greater depth will facilitate the packing of the material, and the circular form of construction does away with corners and reduces the area exposed to the soil and air to the minimum.

In all forms of silo, the inside surfaces must be as smooth as

they can be made, to allow the material to settle evenly, and to facilitate the exclusion of air. Where the walls are rough, the middle settles faster than the edges and air spaces are created at a critical time in the process of fermentation which cause excessive heat and spoilage. When the pits are lined with brick or stone, these should be bedded in mortar or mud, and faced on the inside, to produce a smooth surface as well as to exclude the air which would otherwise be lodged in the interstices.

Although there is some difference in the quality of silage made from different crops, a great many can be successfully used. During the last two years ensilage has been made by the Agricultural Department from the following crops :—maize, jola, grasses, jola and cowpea (mixed), sunflower, sugarcane tops, and sann hemp. Several of the above have been mixed also in different proportions as the material became ready to harvest. Of these, the only crop which proved to be unsuccessful was sann hemp, which gave a product entirely unfit for feed, while jola and maize made the best ensilage. Sunflower makes an ensilage darker in colour than the jola or maize, and possessing a slightly less attractive smell. It is however well relished by cattle, and when fed to dairy cows made no difference to the milk yield, which is the best available criterion of its physiological effect. Whatever crop is used, it should be cut at the right stage, neither too green nor too ripe. When cut too green a loss of bulk is incurred, and moreover the crop has not attained the highest feeding value, while if cut too dry there is difficulty in making a good product due to the lower moisture content and the more fibrous nature of the crop, which also lowers the digestibility of the ensilage. In the case of the grasses the best time for cutting and storing is when the bulk of the grass is in flower, and before the seed has set. For the other crops mentioned, (with the exception of sugarcane tops) generally the best time for ensiling is after the seed is set, but is still in the milk stage. The excellence of the silage depends a great deal upon the time at which the crop is cut, but it is better to err on the side of cutting too green rather than that of allowing the crop to become mature.

The actual process of making ensilage is simple, but at the same time requires to be done properly. The chief necessity is to exclude air. This is the aim which must be accomplished at all costs, and

depends chiefly on proper packing and pressure. When the crop is cut into short lengths this is more easily accomplished but machinery is required for the purpose. Chaffing is however not essential and the very best ensilage can be made from long grasses and jola and other crops, only more care needs to be exercised in making the mass solid and compact. In circular pits this is best done by keeping one or more men in the pit continuously tramping down the material as it is added. In trenches an easier way is to drive a pair of bullocks over the material, or even loaded carts. This should be done until the material is solid and does not give a marked springy feeling. When the material is not packed sufficiently, large air spaces are left throughout it, and a much greater heat is evolved than is desirable during the process of fermentation which follows, and moulds are likely to grow which render the ensilage unfit for feed. The addition of a little water helps very much in solidifying the material, and is especially useful, and in fact essential, when the crop has been allowed to become too dry. From this it may be deduced that no halt is necessary during filling operations on account of rain. Filling should go on continuously once the work is started. After the pit has been filled with as much crop as it will possibly hold, it should be allowed to settle for three or four days and again filled to the top with fresh material, and covered. In filling a trench silo it is better to start filling at one end, and work towards the other end, rather than to attempt to fill the whole trench at once. The latter would only be satisfactory if large amounts of crop were available daily.

When the pit has been completely filled, water should be poured over the mass to effect an air-tight seal, a few inches of waste material, such as old straw or leaves spread over it, and the whole covered with about two feet of earth. If packing has not been well done, the addition of more earth will increase the weight and help to hasten the settling.

After a lapse of six weeks the ensilage will be fit for use. Ensilage, if left undisturbed in the pit, will keep indefinitely and may be left over from year to year if necessary. Cases have been recorded of ensilage being kept for over twenty years, and turning out quite good when used after that interval.

Silage may be safely fed to all adult cattle, including breeding

bulls, and to calves more than four months old. To adult cows an allowance of 30 lbs. may be given daily without in any way upsetting the digestion. In fact, on the Hebbal Farm, the only bulky feed given to the cows is ensilage, and they are allowed to eat all they require. For breeding bulls it is probably better to feed about two-thirds of a cow's ration, or about 20 lbs. Calves over four months old and young stock may be allowed up to twenty pounds a head daily according to size. Sheep will also eat silage and thrive well on it. No difficulty has been experienced in teaching animals to eat the contents of the silo. Most of those fed have taken to it readily at first, and the others never require more than three or four days to become accustomed to what is to them a new kind of feed. Silage should not be fed to horses, as it has a tendency to cause colic in certain individuals.

Table showing approximate capacity of circular silos, 2 days after filling with chaffed material.

Depth of silo in feet.	Inside diameter of silo in feet.		
	6	10	15
	Tons	Tons	Tons
1 ..	·23	·6	1·4
10 ..	3·0	9·0	20·0
20 ..	8·0	23·0	52·0
30 ..	15·0	44·0	93·0

It will be seen that a silo 20 feet deep holds more than twice as much as one 10 feet deep, and that a silo 15 feet in diameter holds more than twice as much as one 10 feet in diameter. This gives a sound basis upon which to calculate sizes required. Where long material is used, the amount of silage stored will be decreased by about 25%.

In trench silos, 6 feet deep, it may be calculated that 23 lbs. of cut material can be stored in one cubic foot, with the same 25% reduction when long material is used.

The Lime Tree Borer

BY

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The study of the lime tree borer comprises three different important aspects. They are, (*a*) life history, (*b*) habits and (*c*) control measures.

(*a*) *Life History* :—The life history of the beetle whose grub is the borer, could not be started from the stage of egg, because I had to begin the work only early September last. The one important point with regard to the life history of the insect was the investigation of the number of broods in a year. As this is directly associated with the application of a sure remedial measure, its importance can at once be realized. It has been known that the adult beetles emerge from their pupal chambers about the beginning of July and begin to mate at once. Not long afterwards the females begin to lay eggs on the surface of small and tender twigs of the plant. These eggs hatch in the course of a few days and the tiny grubs at once begin to bore inside. I began the study of the life history of the borer by collecting a number of infected lime twigs of various sizes from several places in and around Bangalore. My idea was to rear the grubs in the Insectary and to note the larval and pupal periods.

The life history of this insect presented some peculiar difficulties. Most of the borers that I was rearing in the Insectary, enclosed in twigs of different lengths thrived well for some time and were boring in the remaining portions of the twigs in which they were confined ; but after a time some of them began to die one by one probably because, the twigs dried up from day to day and they could not bore further, the tissue being very tough. I was not able to transfer the borers to fresh twigs for the reason that I could not get them, the owners of lime plants being loath to allow me to cut branches from their plants. It was about the middle of November by this time and none of the remaining borers seemed to pupate yet. If there were two broods in a year pupation of these larvae must have already commenced so that the adults of the first brood might emerge at most about the beginning of January, the rest of the period till July being reserved for the second brood. I was always convinced

that there was no such thing as a second brood in the year. To have further confirmatory evidence about this, I proceeded to some of the places where lime trees were infested and inspected them with a view to observe whether the boring and the falling out of the white saw-dust-like substance had ceased. On the contrary, the borers were working away, as vigorously as before. Being now fully convinced that there was only a single brood, I purchased two lime plants of about 4ft. in height each and through holes made in suitable places on the main stems, I introduced two larvae separately, one in each hole to allow them to bore down the stem. I had recourse to this method of rearing the larvae, to avoid the drying up of isolated twigs. The borers, after reaching the base of the stems, began to bore in the central tap root. In the middle of April, one of them suddenly died although I had contrived to leave it under conditions as natural as possible. The other borer kept on boring; but now I removed this borer and transferred it to a fresh plant. It has not yet pupated. It is quite certain from these observations, that the larval period is prolonged from the middle of July or the beginning of August, till the middle of May or so when pupation may take place and above all, that the insect passes through a single brood in a year.

(*b*) *Habits* :—The study of the habits of the lime tree borer has revealed certain interesting points which help us a great deal in the application of a remedial measure. Most of us are aware that on and around infested plants, a sort of white powdery substance can be noted. This is the result of incessant boring in the tissue of the plants and is solely indicative of the presence of one or more larvae of beetles tunnelling in the branches and stem. The saw-dust-like substance falls out through tiny circular holes made by the borers chiefly on the underside of the branches and generally in a spiral fashion on the main stem. The mealy substance is often glued to the outer surface of the plant by means of the exuded juices of the plant. The larvae begin to bore down in the direction of gravity and make small holes at small distances apart. As the pulp materials collect in the bottom of the burrow the insect pushes it first beneath and afterwards behind itself. Then it moves rapidly backwards so that the powder is pushed back with it. In the course of this process small quantities of the material fall out through the several holes already made for the purpose. These

holes also subserve the function of passages through which sufficient air can get inside for the benefit of the borer.

The main characteristic of the tunnelling of the borer is that it is not spiral and irregular in form as in the case of the coffee borer, but is straight and mostly parallel. It must not be supposed that the parallel tunnels are long and continuous from the twigs and branches right through the main stem. They stop at short distances, the longest parallel tunnel not exceeding a length of a foot and a half; of course, the single tunnel in a short slender branch is as long as the branch itself.

The borer does not always work downwards in a continuous way; many times after tunnelling on one side of the branch, it stops, bores transversely thus reaching the opposite side and then bores up on that side and reaches the place from which it first started; next it begins to bore down again now somewhere between the two side tunnels, of course, not exactly in the middle of the branch; when the borer reaches the meeting point of two or more branches it bores up in each of those branches for a short distance before it begins to bore down again. This sort of tunnelling affords the borer, a sure means of escape from injection fluids. In the main stem, the tunnelling is seen to the best advantage and reveals its true nature. The tunnels are generally parallel cylinders each having one or more places of communication with the other; sometimes a single transverse or oblique tunnel crosses the other parallel tunnels, thus communicating with most of the tunnels at that part of the stem. The greatest number of tunnels that I have hitherto found in a single more or less thick stem is eleven. There are gradations from a single tunnel onwards, according to the girth of the stem.

In a single tree I have found different stages of the borers, in different parts. This shows that eggs are not laid all at once and that the borers do not start boring simultaneously. Besides, eggs will not be laid till after about a month from the time when the first beetle emerged and laid its first egg on the plant. So if all the borers live to the age when they can bore in the main stem or root, all of them must be present there; but I have not found it to be the case. In a fully infested long stem, which I cut for examination, I saw that there were not more than five borers alive; a few were found dead here and there. Naturally many borers die half way due to various

causes, such as toughness of the wood, parasitisation and building up of the ant's nests in the tunnels and infesting the borers.

Whenever the borer reaches the base of the stem before it pupates, it proceeds to bore in the main root and its thicker rootlets. A sufficient quantity of air can well get in through the side holes on and various tunnels in, the stem, into the roots. But in this portion of the tree the borer will not progress vigorously for more than a few days and in fact in many cases it dies. The real difficulty which the borer encounters is the manner of disposal of the white powdery substance. This pulp cannot be extruded and so it must collect from day to day. Even if the borer tries to get rid of it by pushing it upwards and out of the holes above the soil the quantity that collects will far exceed the quantity that can possibly be thrown out. The result of this is that the borer suffers partly from want of air and partly from the difficulty of getting food.

Effect on the plant :—I think that the damage done to the plant depends upon the age of the plant when it begins to suffer from the borer attack and the number of borers found in it. A well-grown tree can somewhat withstand the severe effects even when the borers are many, perhaps because of the presence of enough toxic substances in the plant which will render it immune from insect enemies to some extent. A young plant may die in about four months under natural conditions. A grown-up tree, I think, is rendered more or less useless a year or slightly more after the commencement of the severe attack. I have found instances of this fact in the case of lime trees in the City Y. M. C. A. where fine plants of about 3 years of age each died completely at about the beginning of the fourth year. In one of them I found twelve borers inside ; it is possible that some more must have died half way for various reasons. So in all, I think, in a case of maximum infestation we can find about 15 to 20 borers working in a single tree and living on till the time of pupation provided there is nothing in the way.

I have been rather disappointed in not having yet found a single parasite of the lime tree borer although I made several attempts. There are greater chances for parasites, if there are any, to reach the borer in the tree and parasitise it. The presence of numerous holes on the branches and stems leading to the tunnels and the fact that the borer will not close the mouth of the tunnel behind it as it

progresses, just as the coffee borer does, really facilitates parasitisation; but still the borer parasites seem to be few or none, whereas in the case of the coffee borer, parasites are actually found.

Control measures:—These fall under four heads, namely:—

(1) Catching of adult beetles on the wing whenever found by means of hand nets and dusting the plant leaves, as far as possible with lead arsenate so as to poison the adults, especially during the months of July and August.

(2) Destroying eggs when found on the surface of twigs or the petioles of leaves.

(3) Cutting young twigs when they show the earliest signs of infestation and burning them.

(4) Destroying the borer larvae by injecting certain fluids such as phenyle, kerosine, and carbon disulphide into the tunnels by means of small syringe.

I have not had the opportunity to try the first three methods of control due to my taking up the work late in the year. With regard to the fourth I have done some work and injected a number of plants with all the three liquids mentioned above. By the way, I may say that this method of control can only be attempted at a more or less advanced stage of infestation.

The total number of plants, lime and orange, injected by me is 33, of which twenty are situated in the Dewan's compound, 12 in the compound of the City Y.M.C.A. and one in our laboratory compound.

First of all, it is rather difficult to locate the borer inside the plant. A sort of location may be made by choosing the lowest hole on the branch or the stem wherein to inject the fluid. But we cannot be sure that the larvae will be there at the time of injection. If it is there, the liquid will surely kill it; the fact is that in most cases the borer will be too active to be caught at once and killed; it runs to the upper portions of the branches where it may remain or run up to the opposite branch of the plant through the communication. If the borer happens to be in a place where two or more branches meet, it avoids the tunnel into which the liquid is injected and runs up quickly into one of the other tunnels. From a study of the mode of tunnelling and the other habits of the lime tree borer, I am compelled to believe, that the creature inherits along with other characters, the most useful instinct of burrowing in such a way, as to escape

enemies in one form or other. This is why the adoption of the process of injection as a means of eradicating the pest is very uncertain. The effect of the liquid or the gas in the tunnel will not be of a lasting nature. When the borer manages to hide in a safe corner of one of the tunnels for a time, the whole liquid will have evaporated or some of it been sucked up by the plant tissue or the gas will have escaped through some of the holes left open by chance. It may be asked whether the tissue moistened by the poison will not be harmful to the borer. But I think it will not have a deadening effect, because it is certain that the borer keeps away from the poisoned portion of the tunnel for a sufficiently long time, the smell emanating from the stuff being really repulsive to it and so by the time it thinks it expedient to leave the place of safety, greater portion of the liquid will have evaporated and the quantity absorbed by the plant very little. More than once I have detached and cut open tunnelled branches from plants an hour after I injected phenyle into them to see how the borers were getting on. The creatures had apparently understood that the tunnels in which they were hard at work, had been poisoned and instead of continuing to remain there or bore further down, they had turned round in the tunnel, so that their heads were now the other way, and had begun to work in a transverse direction to reach the other side. Thus it is quite possible for the borers to escape the fluid in an ingenious way. A spoilt plant into which I had carefully injected phenyle and kerosene in eight different places, was cut at those places two days after the injection ; I found 8 borers of which only three were dead and the other five as vigorous as before ; this shows that the liquids had not caught all the borers ; if it had, which is not always, they would surely have destroyed them ; that much is certain.

Again when the plants are bushy enough and well protected with thorns it is not possible to reach the places where the larvae are boring ; so this also renders the process of injection inefficient.

I have successfully used a 25 per cent solution of phenyle in injections ; pure kerosene has also been found to be effective ; a 50 per cent solution of phenyle has been found to do a slight damage to the plant. With regard to carbon bisulphide, I have used the commercial stuff with success so far as the destroying of the borers is concerned but the plant has been fearfully damaged. Further

experiments with this liquid are yet to be made with different degrees of dilution, so as to determine the maximum dosage non-injurious to the plant, the minimum dosage lethal to the grub.

On the whole, my short experience in the work of injecting fluids to kill the lime tree borers, has persuaded me to conclude that it never does half the benefit that we really expect from it. The process occupies a long while and requires careful handling but our final reward is not worthy of mention. We can be sure that it is impossible to eradicate the pest completely when once it has set deep root in the plant. The remedy that can be very profitably tried must be one that prevents rather than one that cures and prevention can be effected only by having recourse to the method of cutting and burning young twigs immediately after the earliest signs of infestation are observed. When we have failed to do this, injection can be taken to as the last resort and for what it is worth.

Sulphate of Ammonia as a manure for Sugarcane.

BY

B. Narasimha Iyengar, B.A., Ph.D.,

Agricultural Chemist.

Sulphate of ammonia is being used largely in Java and other cane producing countries as a manure for sugarcane. It is being applied in 2 or 3 doses between 4 and 11 weeks after planting the cane and in quantities varying from 2 to 5 cwts., an acre. It was tried for the first time on the Hebbal Farm in 1920. A plot growing varieties of cane was selected for the purpose, and divided into strips across the rows of cane and each alternate strip manured with sulphate at 250 lbs., an acre when the crop was about 8 weeks old. The whole area received the usual dressing of cattle-manure and groundnut cake at one ton per acre.

Each variety of cane had been planted on three different strips of land, and as the manuring was done across the rows, there were for each variety of cane 9 plots treated with sulphate also and 9 only with cake. Each of these small plots was 1/225 of an acre and only the average results from all the 9 plots are given below. Naturally, there have been some variations in yield from plots treated in a similar

way, but on the whole, the sulphate plots have uniformly given a higher yield per acre as seen from the table below.

Variety	Yield of cane in tons per acre. Check Plot	Sulphate Plot
Red Mauritius ..	34.1	46.3
H. M. 14 ..	27.4	34.5
H. M. 544 ..	40.0	48.4
H. M. 310 ..	24.7	34.3
H. M. 312 ..	41.6	55.7

The increase in yield due to the application of sulphate varied from 7 to 14 tons of cane per acre according to the variety of cane grown. Taking on an average 10 maunds of Jaggery for each ton of cane, the increase in yield of Jaggery works out from 70 to 140 maunds per acre. In money value at 3½ rupees per maund of Jaggery it works out from 245 to 500 rupees an acre. The cost of the sulphate applied according to the then prevailing prices was only Rs. 45. Adding to this the cost of manufacturing Jaggery at a liberal rate of as. 8 per maund, the expenses vary between Rs. 80 and Rs. 115 per acre. Subtracting these figures from the value obtained for increased yield of Jaggery, the net profit works out from Rs. 165 to Rs. 385 an acre according to the variety of cane grown.

To test these results on a large scale and under different conditions of soil, climate and cultivation, similar experiments were conducted in co-operation with some of the members of the Agricultural and Experimental Union. 14 plots were selected for the purpose in different parts of the State and sulphate of ammonia applied when the crop was 6 to 8 weeks old. The results of the experiments which have been received till now are given below.

Locality	Variety of Cane	General manuring	Yield of cane in tons per acre. Check plot	Sulphate plot 250 lbs an acre	500 lbs
Uragahally	Local striped	Cattle manure and cake at one ton per acre	15	17.0	—
	H. M. 544	Do	25	33.0	—
Honnur near Davangere	Red Mauritius	Only cattle manure	27	33.0	45
Talagavara (Chintamani)	Local striped	Do	25	34.0	38

Owing to certain peculiar conditions under which the local striped cane was grown at Uragahally, the yields from that variety have to be left out of account. The local cane was grown between two strips of H. M. 544. The latter, being a more vigorous variety, seems to have smothered the local variety very badly. On the bulk plots, and with a manuring of 1½ tons of oil cake to the acre, the local cane yielded at the rate of 25 tons to the acre. Grown on a separate plot and not between two plots of H. M. 544, the local cane too would probably have responded better to ammonium sulphate.

Coming now to the variety H. M. 544 grown on plots of 1/20 acre, it is seen that sulphate of ammonia has increased the yield of cane by 8 tons to the acre or the yield of Jaggery by 80 maunds per acre. Sold at Rs. 3-8-0 a maund, this fetches Rs. 280, and the expenses are Rs. 45 for the sulphate and Rs. 40 for Jaggery making or in all Rs. 85, thus leaving a net profit of nearly Rs. 200 an acre. Encouraged by these results, Mr. Krishnaiengar has purchased enough sulphate for trial on 20 acres of land.

The results of experiments with Red Mauritius at Honnur show that the first dose of manure has increased the yield by 6 tons of cane to the acre, and the second dose has given a further increase of 12 tons of cane. Comparing this with the results obtained on the Hebbal Farm in 1920 it is seen that Red Mauritius cane has given the same yield with one ton of cake and 250 lbs. sulphate as with 500 lbs. sulphate only. The cost of manuring in the first case works out to Rs. 125 whereas in the latter case it is only Rs. 90, thus effecting a saving of Rs. 35 in the manure itself and without any decrease in the yield. The effects of the sulphate of ammonia at Honnur would have been greater had it not been for a heavy shower of rain a few weeks after the application and consequent surface wash which damaged the crops very badly.

The results at Talagavara with local cane show an increase of 9 tons of cane for the first dose of sulphate, and a further increase of only 4 tons to the second dose of manure—a small illustration of the law of diminishing returns.

Another set of experiments with local cane at Kylasanhally, near Bangalore, was tried. But unfortunately the yields were mixed up before being weighed. Anyhow, the party seems to have been

satisfied with the results, and as a result of it, has bought manure sufficient for 10 acres of land this year.

The experiments are being repeated on the Hebbal Farm. There was not that marked difference between the sulphate plot and the cake plot in 1921-22 as there was in the previous season. Whether it was due to the scarcity of water which was felt rather keenly for a few weeks after the application of the sulphate or to any other causes remains to be studied. It had been observed in the previous season that those parts of the plot which showed a poor growth of cane under ordinary treatment showed the best growth when sulphate of ammonia was applied. This result of the effect of sulphate of ammonia has been confirmed during the season 1921-22 as well.

As already stated, sulphate of ammonia is being applied in other cane growing countries in 2 or 3 doses at different times between 4 and 11 weeks after planting and in quantities up to 5 cwts., an acre. Experiments will be undertaken in the near future as to the best time of applying it to cane and finding out the most economic dose as well.

The results of the other experiments too will be published as soon as they are received.

Notes on the more Important Insect Pests of Crops in the Mysore State.

BY

Mr. T. V. Subramania Iyer,

Assistant Entomologist, Mysore Agricultural Department.

(Continued from our last issue.)

8. Coccidae. Scale insects.

The insects are generally destructive to fruit trees and permanent crops like coffee, tea, rubber, etc. The most important in the State so far noted are :—

(a) Green Bug.

Coccus Colemani, **Kann.**

Mys. Ent. Bull. No. 4.

Ind. Mus. Notes II 193, *p.* 166 *& III b*, 1894, *p.* 18.

This insect is the notorious "Green Bug" of the Coffee Estates. It is found in almost all coffee estates in Mysore and estates in lower

altitudes suffer most from this insect. The pest is very marked on coffee in the summer months, *viz.*, March-May. The pest was noticed on coffee in the estates for the first time a few years ago and very vigorous measures were adopted against the pest. After 3 or 4 seasons' work it was found that 2 kinds of fungi—a black (summer form) and a white (cold season form)—keep the bug under check to a very great extent. Spraying work in the estates was discontinued from then. Guavas, Citrus trees, ægle marmalos and Ficus trees are the older host plants of the bug.

Control.—Spraying with fish oil resin soap and the introduction of the fungi wherever they are not found are being done in the different estates in the Province.

(b) Brown Bug.

Saissetia (Lecanium) hemisphaerica.

Mysore Ent. Bulletin No. 4.

This is the "brown bug" of the coffee estates and is found in all coffee estates either on coffee or other plants. It sometimes occurs as a pest of coffee.

(c) *Pulvinaria psidii,* **Msk.**

Mysore Ent. Bull. No. 4.

This insect is known popularly as the "mealy bug". It is very widely distributed throughout the State. It is generally found on guavas, coffee, ficus trees, mango, citrus trees, etc. Guava trees are particularly subject to the attack of this insect. The insects are easily made out by the white cottony substance attached to the anal end of the female bug. The badly attacked plants are covered with "sooty mould" so that the plants look quite blackish and the leaves and the branches have a shining appearance. In the earlier stages of the development, the insects look very much like green bugs but the dark loop is wanting.

(d) *Pulvinaria maxima,* **Green.**

Imp. Dept. Agr. Pusa, Ent. Bulletin 87, *p.* 28 ; *pl. VIII.*

This insect is found commonly on Margosa trees. It has a wide distribution. It is found in the Shimoga, Bangalore and Chitaldrug Districts. Trees look quite black on account of the "sooty mould "; the branches and leaves are covered by the insects in all stages of development. Large number of the big black ants (*Camponotus*

Compressus) are found going about amidst the colonies of the scale insects. The bugs were once found very bad on a large number of trees in Santebennur (Shimoga District), and Sasalu (Chitaldrug Dt.) in June.

(e) *Phenacocus insolitus*, **Green**.

Imp. Dept. Agr. Pusa, Ent. Bull. 87, *p.* 42, *pl. XIII.*

This insect is found as a pest of brinjal plants in Chickballapur and Bangalore, in September. The infested plants are made out by the curled up leaves and the whitish appearance of the whole plant due to the innumerable white curved ovisacs of the insects.

(f) *Pseudococcus longispinus*, **Targ.**

I. M. N. IV, 1897, *p.* 75, *Ent. Bull., Pusa, No.* 87, *p.* 40, *pl. XIII.*

This mealy bug was first noticed as a very bad pest on grafted mango trees in a garden at Chickmagalur (Kadur Dt.) in March. The main stem, branches and under-surface of the leaves were covered with masses of these white scales and the trees looked black with "sooty mould". The insect can be easily recognized by the two long white tail-like processes sticking out of the anal end. Many of the insects in the earlier stages will be found slowly moving about the branches and leaves of the trees.

Control.—Three sprayings with Kerosene emulsion checked the pest.

(g) *Aspidiotus cydoniae*, **Comst.**

Ent. Bull. Pusa, 87, *p.* 19, *pl. III.*

This is an insect belonging to the class called "armoured scales," a hard covering protects the soft insect inside. The insects are a pest of grape vine and apple in Bangalore and Chickballapur (Kolar Dt.). They are more serious on the former than on the latter. They cover the canes of the grape vines completely and these dry up as a result. They also cluster round the leaf stalks and underneath the leaves, the latter turn yellow and drop down. A large number are found in the fruits and leaf buds, so that after pruning, the sprouting shoots look unhealthy, and in bad attacks the buds dry up and do not sprout at all. In the apple they are commonly found clustering round the eye of the fruit and the fruit stalks. The attacked portions show up a scarlet colour.

(h) *Aspidiptus tamarindus*, **Green**.
Ent. Bull., Pusa, 87, *p.* 20, *pl. III.*

Dense masses of these cover the fruits of tamarind in Malur (Kolar) and Bangalore. The leaves and small twigs are also found fully covered. The insects resemble the above two scales in appearance and I am not sure if they are the same as the species mentioned in the bulletin quoted above.

(*i*) *Aspidiotus triglandulosus*, **Green**.
Ent. Bull. Pusa, 87, *p.* 21, *pl. V.*

This insect is very common on jack trees in Bangalore and Chickmagalur (Kadur Dt.). In several trees, the small twigs were found to be covered with masses of these scales, so that in a year the majority of them were found to be quite dry. They also cluster along the ribs of the leaves underside. The scales are very minute and ashy black in colour when large numbers are found clustering round a twig.

(*To be continued*).

A Note on Castration

BY

B. V. Venkatachari, G.M.V.C.,

Veterinary Inspector, Kolar.

Castration of animals is a time-honoured operation performed all over the world in different methods. The methods that obtain in our country are mulling the testicles and bruising the spermatic cords just above the testicles. Both these methods are attended with great pain and considerable swelling of the scrotum and its contents, but in spite of these the animals get on well after some time. But with the advance of civilization in the Western countries and with the advance of Veterinary science, more humane surgical methods have been adopted for performing this operation. Similar methods are being adopted in our country by the Veterinary Department created by the Government for the alleviation of the sufferings of our dumb friends. The little band of Veterinary Inspectors under Government service are doing as much as they can in this direction with success varying according to the ready co-operation or otherwise of cattle owners in different parts of the State.

One chief reason why the ryot does not take to it more readily is his innate suspicion and indifference to anything of a new order. It is not so in a Westerner. His nature seems to be to place implicit confidence in a doctor whether of man or animal. The absence of this sort of temperament in our ryot, by the way, may be due to want of that general education which widens one's outlook. While day by day, the Government are creating more facilities for him in this direction, it is also well that he hastens to shake off this characteristic in him and co-operate with Government Departments such as ours created for benefit.

Returning to the subject, the chief objects of castration of animals are (i) To render vicious animals more docile. (ii) to prevent wasting away and make them more hardy and look better. (iii) to prevent useless sires from propagating. The first two objects, the ryot does appreciate but the third and the most important, he does not so well appreciate although he is aware of its baneful effects on the stock of his village or country, for he defers castration of his animal until it cuts 2 or 6 teeth. He has a notion that if it is castrated before it cuts 2 teeth or while in 4 teeth, the fore parts will not develop proportionately to the hind. I am doubtful how far this theory is sound, for, as a matter of fact, everybody can see the well developed and hardy animals of the Amrut Mahal Department working in the Transport Corps in spite of early castration. I am inclined to think that the reason for his putting off castration until his animal cuts 2 or 6 teeth may be due to the fear that the scrotal sack might burst in the mulling mode of operation if done earlier, for the part is naturally more tender. But he need have no such fear in the surgical method adopted by the Veterinarian, for the testicles are entirely removed and all precautions taken for the animal to get on well after the operation. On the other hand the earlier the operation the better is it for the animal. It is as well here to impress upon the cattle owner the following advantages of the surgical method over the mulling or bruising method.—

(i) There is considerably less pain and the operation is quicker. The animal immediately after moves about as if nothing had happened to it unlike in the mulling operation. It grazes or feeds on the fodder it is accustomed to as usual. There is no necessity for the cattle owner to wait for a particular favourable season of good

pasturage and harvesting for having the operation done as is the case in the local methods, although no doubt such a season is desirable and perhaps more advantageous for the animal to put on flesh.

(ii) No remnants of testicles are left just as in many instances seen in the local methods. As the result of imperfect mulling many animals remain vicious and do not thrive well.

(iii) Animals more or less a year old can be castrated with impunity.

(iv) Animals whose testicles have not properly descended into the scrotum cannot be mulled and such can be done by the surgical method of the Veterinarian.

In the light of this brief note it is earnestly solicited that every cattleowner who has interest in the improvement of Live-Stock of the country and particularly the scrub bull owner will wholeheartedly co-operate with the Department in their campaign for making the country free from the curse of these scrubs and thus pave the way for breeding from better sires.

Trial of Groundnut Varieties at Kappalmadagu, Mulbagal Taluk.

BY

K. Nagegowda,

Patel, Kappalmadagu.

I sowed during the last season three varieties of groundnuts—Sogatoor, Carolina, and Mauritius—sent to me for trial through the Mysore Agricultural and Experimental Union. They were sown in rows one foot apart with check plots as per instructions furnished. The seeds germinated well and as there were frequent showers for some time after sowing, the plants came up very well. But later on due to the failure of rains the plants began to wilt. About flowering time rains were received again and the plants recovered and turned green. But due to insufficiency of rain at the time of the formation of pods the plants commenced wilting again. For about a month at this time there was no rain and as the result, the late formed pods did not form seeds but were empty and the first formed seeds did not

mature properly. Digging was very difficult due to failure of rains. About the end of December the pods were dug out with extra expense as these were experimental plots. The following is the yield of crop. Of the three varieties Sogatoor has given the largest yield. During the period of growth, Mauritius appeared the best. As the season was not favourable, it is not quite right to say that Sogatoor is the best variety for our conditions. The trial will have to be continued over one or two more years.

As the crop was left in the soil for a long time without being dug out, the pods had dried up very well and measured less, comparatively.

	Plot I	Plot II	Plot III	Average	Per acre.
Sogatoor	14 seers	15 seers	15 seers	$14\frac{2}{3}$ seers	$586\frac{2}{3}$ seers
Carolina	9 ,,	10 ,,	13 ,,	$10\frac{2}{3}$,,	$246\frac{2}{3}$,,
Mauritius	11 ,,	14 ,,	12 ,,	$12\frac{1}{3}$,,	$493\frac{1}{3}$,,

N.B.—Each plot was one gunta (1-40 *acre*) *in extent.*

NOTES AND COMMENTS.

By the Editor.

Agricultural Credit in Germany.

The February number of Landw Jahrbucher contains an article by Alfred Helmstaedt on the above subject. The first part deals with the exclusion of the small farmers from the benefits of the credit system and its effect on the development of agriculture and economics of the country. The second part deals with the preliminary measures undertaken to organize credit for the benefit of the small farmers and traces the whole development from 1848 up to 1919. The third part deals with the principles on which the credit system was based, their effects and weak points. The fourth part deals with the development of the system since 1919 with special reference to the principles on which it is worked, and then follow some concluding remarks of the author. The whole article covers more than a hundred pages and we intend to publish a summarised translation of it in course of time for the benefit of our readers.—[B.N.I.]

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Agriculture Without Turning the Soil.

With the above title a book has recently been published in Germany, containing the experiences of the author from 1910-1920. He seems to give methods for keeping the surface of every soil free from crust-formation, friable and in a state of fine tilth, and free from weeds with the object of producing fertilising gases in the soil to satisfy the food requirements of the ordinary field crops. After getting the book we shall go more into the details of it and discuss how far these methods may be applied to our conditions.—[B.N.I.]

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Manurial Experiments in the former German Colonies in East Africa.

The results of these experiments carried out from 1911-1915 have recently been published as a contribution to the knowledge of East African Red Soils and Laterite Soils and the following are some of the conclusions arrived at.

(1) The extraordinary action of giving heavy dressings of lime to laterite soils is due to the improvement of the mechanical condition of the soil.

(2) On ordinary red soils liming has had no effect.

(3) From innumerable pot and field experiments it has been proved that nitrogen is wanted the most.

(4) As sources of nitrogen, Calcium Cyanamide, Nitrates and Sulphate of Ammonia have all proved equally satisfactory. Cyanamide has not shown any bad effects even when applied just before sowing. On account of their being easily leached out, nitrates are to be applied with great care and in small doses as top-dressing. On all normal Red Soils, Sulphate of Ammonia has not shown any bad effects.

(5) Nitrogen supplied as green manure, grown on the spot or brought from elsewhere, has been found to be very beneficial.

(6) Next to nitrogen, the soils seem to be in need of potash. Though the better classes of red soils do contain a certain store of potash not easily soluble, the supply does not seem to be enough to produce heavy yields when manured with nitrogen.

(7) Phosphoric acid seems to be required the least. Though only small quantities of it are found in Red Soils and become slowly available to the plants, yet there seems to be a sufficient supply in the soil. In dry seasons, manuring with phosphates has been found to be very beneficial to field crops. Superphosphate has given satisfaction even as top-dressing to cereals, vegetables, maize, etc.

It remains to be found out how far these results are applicable to our Red Soils and Laterite Soils.—[B.N.I.]

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Proceedings of the Board of Agriculture held in India in February 1922.

We are particularly interested in Resolution No. 5 of the Board which does not endorse the recommendation of the Sectional Meeting of Chemists and Bacteriologists regarding the measures to be adopted to ensure the continuity of field experiments of a permanent nature. We do certainly realize the difficulties of any experiments being conducted by a Board of Experts. If at all manurial problems connected with the crops and soils of this country are to be solved scientifically, we are of opinion that each province should have farms

under the direct control of the Agricultural Chemist and run on lines somewhat similar to those of Rothamsted. Problems connected with manures have mostly been tackled by Agricultural Chemists and we do not see any reason why they should not be given facilities to do their legitimate work for the benefit of the country at large.

[B.N.I.]

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Colour in Cattle.

We publish among our extracts, one taken from the Live Stock Journal *anent* colour superstitions. The subject is of interest to agriculturists in Mysore, where much stress is laid on such points as colour in cattle which are after all of secondary importance. While acknowledging the fact that an attractive colour among other fine points is desirable in good animals, we strongly oppose the common standpoint that a "good" colour is preferable to strong conformation in cattle. The old adage that "a good horse is never a bad colour" applies equally to cattle, and a rider might be added to it that "a good colour does not constitute a good animal." While this is equally true, it is in direct opposition to common practice in this country. We have seen fancy prices paid for breeding bulls, with legs and feet totally unsuited for hard work, all on account of what is regarded as a good colour. The stock got from such breeding animals are more certain to inherit the weak conformation than the strong colour. No man in his senses would buy a cart with a broken wheel, or a plough with no share because it was painted in an artistic manner, let alone pay a fancy price for it. And yet the shortcomings of these are confined entirely to themselves, whereas the breeding bull passes his faults on to his offspring, and perpetuates what should be suppressed and abolished. Colour is after all entirely a matter of opinion and in no way increases the capacity of an animal for work, whereas soundness and suitable conformation is a matter of necessity and can only take one form. Too much emphasis cannot be laid upon this point, and the importance of form over ornamentation is paramount. Moreover, to the true stockman, no badly built animal is ornamental, no matter what its colour may be or how many of the so-called "fine" points may be represented.—[W.D.]

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Ensilage.

The attention of our readers is drawn to the article on ensilage published in this issue. It is difficult even for those familiar with this method of preserving fodder to fully conceive its importance to the cattle owners in the State. The preparation of ensilage as a method of utilizing fodder which would otherwise be wasted, and of making that fodder available at a time of the year when a scarcity of fodder is general, holds out potentialities which are enormous. This is specially true in the case of the Malnad, but that in no way diminishes the importance of the subject to the Maidan section. In the Malnad, as the article points out, large quantities of good grass are allowed to become dry, innutritious and unpalatable to cattle every year, while nothing grows or is provided to take its place in the hot months which follow this annual catastrophe. The silo pit offers a solution to this difficulty which it seems pure folly to neglect. Much is heard of the need for so-called "drought-resistant grasses", or in other words, grasses which will grow in the hot months when there is no rain or soil moisture. Why should not this demand be extended to our staple crops? Why not cry out for sugarcane and paddy which would grow without irrigation, ragi, jola and other crops which would grow without rain? The demand seems equally logical. We admit the desirability of such a state of affairs, but common sense tells us that plants composed largely of moisture are not likely to be able to manufacture it for themselves where no moisture is. In the old days, many men went mad trying to discover the elixir of life, others lost their reason in the effort to transmute the base metals into gold, having completely lost sight of the value of those base metals. Let us therefore profit by this example and turn our attention to making full use of the facilities at hand, rather than spend our short span of life in shrieking for the millennium. The silo comes under the former classification and no claim toward the latter is made for it. We recommend our readers to seriously consider the possibilities of ensilage as a valuable means of conserving fodder and improving live stock.—[B.N.I.]

Our Query Column.

Q.—I have seen great claims proclaimed for the method of milking thrice a day in your Journal. As far as my experience goes with my cows and cows in general in these Malnad parts, milking once a day seems to be more beneficial. Here the cows give 2 to 3 lbs. of milk per time and that any cow that gives more than 5 lbs. per time is of superior order. Here stall feeding is very rare and cows will have no food supplied during the nights. What they graze during the day time is all that they have to subsist upon. Such being the case the condition of the cows is very deplorable. The cow has very little milk to feed the calf with and if all the milk is drawn away and the calf ill-fed, it is self-evident that the calves become skeleton-like very shortly.

On the other hand if the calves are let go with their mothers at 7 A.M. in the morning, they graze along with the mother jumping and frolicking till 4 P.M. when they are to be tied separately. The cow is milked only once in the morning. Between the last previous suckling of the calf during the day and the morning milking time, there may be 16 to 18 hours' interval. The greater the interval the greater does the udder distend and the greater the store of milk in the udder.

Points to which attention should be drawn in this "only once" method are :—

(1) This method is only for poor cows.

(2) Greater distension of the udder, and consequently the organ may grow bigger not only in size but in physiological function.

(3) Calves grow healthy, they learn to cud the grass earlier, lead a free merry life with their mothers, and there is a sort of cheerfulness both with the mother and the calf.

(4) All the four teats in the udder can be milked as the calf will be grazing with the mother during the day.—[M.V.]

A.—In the extract, presumed to be under reference, namely from the Agricultural Gazette of Canada, published in Vol. 11, No. 4, of this Journal, the report in favour of milking three times daily was in the case of high producing cows, yielding 60 lbs. and over. Certainly nothing is to be gained by milking a cow with a total yield of 3 lbs. a day, more than twice in twenty-four hours. The effect

of milking three times daily was tried in this Department on cows giving between 15 and 25 lbs. a day. The effect was to increase the daily production by about 1 lb. on the average, but the extra work and dislocation of routine involved was not compensated for by such an increase. In cases of a daily yield of 40 lbs. or more, milking three times a day will increase the yield to an appreciable extent, but whether the increase is sufficient to warrant such a procedure depends entirely upon circumstances.

On the other hand, the theory that greater distension of the udder would increase the "physiological function" is a false one. Stimulation is given to the udder by manipulation, and leaving it in a quiescent state, even though distended, is a certain way of reducing the milk flow. The Hegelund system of manipulation which is claimed by men of experience to increase the yield, emphasises this statement.

It may be safely stated that, in the case of the average Malnad cow, the feeding of a small quantity of concentrated feed, such as groundnut cake, would increase the yield of milk, sufficiently to repay the cost, and thereby assist in the growth of the calf by making more milk available to it, provided that the extra amount is not also used for domestic purposes.—[W.D.]

Correspondence.

To

THE EDITOR,

The Journal of the Mysore Agricultural and Experimental Union.

Sir,

While so many theories are being propounded with regard to the flowering of the sugarcane, the following might be of some interest to your readers. One series of experiments on the Hebbal Farm is given over to testing the effect of large doses of Hongey (*Pongamia glabra*) and castor (*Ricinis communis*) cakes on sugarcane. In this experiment the plot is divided into a series of equal and narrow strips, and each of these strips is treated in a particular manner. Every third strip is treated as a check and does not get any cake,

while the two strips in between two checks are given castor and hongey cakes both of which are given at the rate of two tons and three tons an acre. While the general growth of canes and the colour of the leaves is different in different strips, what is of more immediate interest to us is the difference in the flowering of the canes in the different strips. The canes in the check strips have arrowed freely while those in the other plots have not arrowed so freely, and the arrowing while present to a very limited extent in the two ton strips, is almost absent in the three ton strips. The oil-cakes being essentially nitrogenous organic manures, it looks as if a heavy dose of such manure, while materially assisting the growth of canes also retards the flowering to some extent, thus giving a longer time for the vegetative growth of the plants which, as a consequence, are more robust and weigh more than when so much time is not allowed for their growth. Thus a deficiency or the absence of an abundance of plant food in the soil seems to be one of the factors inducing the arrowing of canes. That organic Nitrogen is one of such plant foods, now seems fairly evident. It would be interesting to see how deficiency or abundance of phosphoric acid will affect the flowering.

Incidentally it has shown us that heavy doses of cakes give big yields not only due to the increase in the growth of the canes but also due to a lengthening of the period of growth by putting off the time of flowering. I need hardly say that all this will have to be confirmed by observation in the coming seasons.

HEBBAL FARM. GUNDAPPA S. KURPAD,
Vice-Principal, Hebbal Agricultural School.

SELECTIONS.

I

Longevity in Seeds.

Some useful information concerning the longevity of the seeds of some of the commoner crops of the temperate regions has lately been published by the Seed Branch of the Canadian Department of Agriculture. The seeds were stored in cotton sacks which were kept at ordinary room temperature in a galvanized iron chest with a lid. Once a year in late summer they were tested for germination. The records thus permit a comparison of their viability after various lengths of time in storage. The viability of wheat remained constant for six years, and then gradually decreased till about the end of the eleventh year, when a very rapid diminution in viability took place till the fifteenth year, when germination ceased. The viability of oats, on the other hand, increased for about six years, and then gradually fell till it was below zero after twenty years. It would be exceptionally interesting to have information of this sort for the various strains of cotton which are cultivated in the West Indies. It appears that the longevity of certain seeds may be greatly prolonged by desiccation. Thus Becquerel has endeavoured to find out whether or not there may be an entire suspension of vitality. He first found that dried seeds of various kinds, on being placed in pure and dry nitrogen for a year, did not liberate a trace of carbon dioxide, and yet germinated subsequently. He then showed that grains of wheat, after perforation of the seed-coats, and desiccation for one year, could be exposed for seventy-seven hours to the temperature of liquid hydrogen (—253° C), and that nevertheless they retained their power of germination. He concluded from his experiments on certain seeds that an interruption of life is not only possible, but actual, without there being any indication of a limit to its prolongation. These considerations should be of the first importance to those whose business lies in the handling of seeds.— *The Agricultural News, October* 16, 1920.

II

White Cattle Superstitions.

There are two old adages which perhaps require a little explanation in these days. One is "A white calf is born with a knife at its throat," and the other, "A white beast is the first to find its way to the slaughter-house."

Now, the proverb, "A good horse is never a bad colour" was not applied to cattle a couple of centuries ago. It was firmly believed by our grandfathers that white cattle were physically weak, that they did not thrive as well as those of other colour, that it was difficult to get them fat for the butcher, that they were disliked by the other stock which did not settle well in pastures in which white cattle were turned, and that they were especially liable to lousiness and other ailments, which they would spread amongst others of the herd. There would be much prejudice even now to an all-white bull, though one no longer finds breeders so anxious to sell white calves to the butcher simply because they are white, as was the case up to half a century ago. So early as 1787 Marshall in his "Rural Economy of Yorkshire," in dealing with the cattle in the Vale of Pickering, refers to this dislike of white cattle and the superstitions prevalent in his day. He wrote :—

A "raw nose" — that is, a white muzzle, with nostrils red on the inside — is considered as a bad mark, portending a tender animal ; on the contrary, a black or brown muzzle, with dark coloured nostrils is esteemed a sign of hardiness. A calf entirely white is generally rejected under a notion that white cattle are of a tender nature ; that they are peculiarly subject to lousiness ; and that they are disliked by their associates. The finest ox I ever knew of the Holderness breed was white. The finest ox I ever saw of the Teeswater breed was white. One of the finest cows in Wales is white. Nevertheless, valuable calves are annually sent to the butcher merely because they are all white. The smallest speck of colour, even the tip of an ear, red or black, saves them from proscription, under a notion, no doubt, that it hardens their nature, defends them from lice, and renders them acceptable to their companions — a vulgar error which is not confined to this district, but which ought, in my opinion, to be universally exploded.

III

Substitution of Vegetable Oil for Paraffin as Fuel for Motors and Tractors in the Colonies.

It is very difficult and costly to transport American and Asiatic petrol into the interior of certain tropical countries. All goods must be carried by native porters, as animals cannot be used because of diseases transmitted by insects, such as tsetse flies, etc. But native porters are also expensive and because of these reasons it is advisable to replace them by mechanical transport if a good, cheap fuel can be found in the country.

In October 1919, the author proposed that the Belgian Colonial Ministry should organize a trial of road tractors using palm oil as fuel. This was done in July 1921, and not in 1920 as was first announced.

But trials directed by an engineer, Mathot, have already been carried out using palm and cotton oils, in England and Holland. Mathot carried out complete trials, determined the fuel composition, and drew up many diagrams. A detailed report will eventually be published when certain experiments that are still taking place have been finished.

The results obtained have opened up vast prospects of the development of Central Africa and other Colonies. They can be summarised as follows :—

(1) Palm oil like cotton oil, when used as sole fuel in semi-Diesel, 2 or 4 cycle engines, gave full satisfaction. The engines ran normally, and the power developed is equal, if not greater, than that obtained with kerosene. The fuel consumption, at full load, of 15—25 H. P. motors tested over 12–15 hour runs, varies between 262–230 grammes per effective H.P. hour.

(2) Nothing was noted that suggested possible difficulties in using palm oil in semi-Diesel engines. The diagrams are normal. Starting up, without petrol injection, is good, there is no carbonisation, the exhaust gases are clearer than when paraffin was used. Water injection was neither necessary nor desirable. All that is required is to melt the oil by placing it near the exhaust, or running the feed pipe in a coil inside the exhaust.

La Societe Belgo-Americaine "La Forminiere," (which holds diamond and rubber concessions) possess 3 tractors that run on palm oil and just have ordered 2 more. This oil is also being used at a wireless station in the Belgian Congo.

Semi-Diesel engines tested in Belgium in 1919 gave the same good results. A Swedish engine, the Drott, was tested at Brussels some time ago in the presence of Renkin, former minister of the Colonies.

The semi-Diesel engine is very suitable for propelling boats, locomotives, tractors and fixed machinery, and is of great practical utility for colonial use. Machines will probably be soon available which in normal times will not cost more than 5–10 centimes for fuel per effective H. P. hour. It is thus evident that vegetable oils, so varied, abundant, and cheap in the tropics, can replace paraffin as a fuel for semi-Diesel engines.—*International Review of the Science and Practice of Agriculture Year XII, No.* 4.

IV

Avoiding Faulty Plough Construction.

Due to causes now so well known, there is a belief, fast becoming widespread, that British agricultural engineering is almost purely empirical. Of course, it is nothing of the sort, and although the need for intensive research is equally obvious, it is as well to remember that several of our leading firms go to great trouble and expense upon laboratory experiments, and that pure research is in no sense unknown to a great industry. In the case of tillage tools, for example, the War revealed that British manufacturers had more than a passing acquaintance with the conditions in which these were required to work at home, and the result was the modification, complete or partial, of many imported ploughs to conform more nearly to the British made models, which so peculiarly suited British soils and farming practices. The home farmer dearly loves a clean-cut furrow slice, but his *vis-a-vis* of other nationalities has not always the same keenness in this direction. To-day, therefore, by far the greater proportion of ploughs sold in this country represents those designed to meet British requirements. A standardised solitary type, of course, is not maintained, for there are slight differences and variations. But even to-day it will generally be found that many British models are yet distinctive. They are made to give width between the plough bodies so that the slice shall be well and truly laid over. "We give you distance between the bodies to turn the furrows," said the head of one firm, "others give you height. We sacrifice height for distance between the bodies so that you get ample room in which to work your skims or discs to clean the land properly." On the other hand, many imported implements are built more for height or depth, something more in keeping with the digger type, and are said not to choke up so readily as the other patterns. Both designs have their supporters and their de-tractors. Some urge that the one chokes up quicker in dirty land than the other, and here is matter wherein an independent State testing station might give us, impartially and fearlessly, much needed guidance. But to revert to private research, we might say that as practised by certain firms it is altogether a fascinating study. In metallurgical matters the tests are deep and radically exacting, for the wearing and strength of the materials are vital points. But even more important are the particularly agricultural engineering points. Take, as an instance, the problem of scouring, with which is inseparable the pertinent subject of draught. In one case of which we know every possible step is taken to ensure that a plough breast shall scour thoroughly, and to this end

the services of a laboratory staff are frequently enlisted. A plough comer through a practical field test apparently scatheless and with honours. To the keen observer the plough breasts appear unscratched and also to have scoured well. But the examination in the laboratory is so far more critical, and under special microscopic tests there may be revealed faint marks, the slightest of scratches. That revelation is sufficient. Those scratches indicate the points of soil adherence in future work, and reveal how scouring ceases to be so thorough as it ought, and where increased draught begins. And so the reconstruction of the plough is begun with the one aim of perfection, because that quality is the recommendation against which competition is powerless. The farmer, therefore, can rest assured that the manufacturer's interests and his own have very much in common.—*The Implement and Machinery Review. Volume* 47, *No.* 561.

V

The Dwarf Coconut.

"The 'dwarf' or 'King' Coconut is attracting a certain amount of attention at present, chiefly through the articles written by Mr. Handover, who is so thoroughly and consistently optimistic as to be more or less convincing, and as it is possible that these articles may influence prospective investors, the statements and predictions made require careful investigation.

"In an article, published in September-October, 1919, of the F. M. S. Agricultural Bulletin and reproduced in the Planter's issue of August, 1920, Mr. Handover arrives at certain estimates from various data, principally the following:—

" 'Trees 30 years old or so occur in different parts of the Malay Peninsula, and many of them still bear abundantly.

" ' A spike from a six-year-old palm has been noted with 200 female flowers, while trusses of fruit from similar trees have been found with as many as 55 ripe nuts.

" 'Six-year-old palms have been counted with as many as 234 nuts on (excluding ovules), and the trees average 80 nuts a year.

" '*The only figures available are those from Sungei Nipah.*

" 'In 1912, 500 acres were planted with dwarf coconuts at Sungei Nipah.'

"The yield of individual trees, or clumps of trees, planted in and around kampongs, is no safe basis for a scale of production on large areas. In 'A Practical Guide to Coconut Planting,' by R. W. Munro and L. C.

Brown, we note: 'Some very fine palms may be seen in these small plantations, yielding in certain cases an average of quite 100 nuts a tree per annum.' Were we to take this as the basis of an estimate of yield, the result would be, assuming 48 trees an acre, 4,800 nuts, or 21 pikuls of copra an acre, whereas the actual returns from estates under European management give an average of anything from 7 to 12 pikuls. (The reference here is, of course, to the ordinary palm.) No estimate of practical value can be made except from authentic figures of production from areas of commercial extent, extending over a few years, and with the exception of those from the comparatively small area on Sungei Nipah, none such are available with regard to the dwarf coconut.

"In Mr. Handover's article, quoted above, the following is given as a conservative estimate of production :—

End of 4th year	.. ..	10 nuts a tree.
,, 5th year	.. ..	30 ,,
,, 6th year	.. ..	60 ,,
,, 7th year	.. ..	80 ,,
,, 8th year	.. ..	100 ,,
		280 nuts a tree.

"At 90 trees an acre, and allowing 500 nuts to one pikul of copra, this would give 50 pikuls of copra an acre to the end of the eighth year from planting.

"In a more recent article, Mr. Handover gives the actual results from Sungei Nipah, as follows :—

"End of 5th year	.. ..	1 pikul an acre.
,, 6th year	.. ..	5·7 pikuls an acre.
,, 7th year	.. ..	3·6 ,,
,, 8th year	.. ..	5·9 ,,
		16·2 pikuls an acre.

Allowing for cultivation being neglected and the loss caused by pests, etc., it is difficult, if not impossible, to reconcile Mr. Handover's estimates with his actual results. The return is less than one-third of the prediction.

"The actual crop of 5·9 pikuls copra an acre in the eighth year does not compare favourably with the ordinary coconut grown on alluvial or other suitable soil, from which 1,503 or 6·6 pikuls of copra an acre is an estimate repeatedly reached and frequently exceeded at the same

age. It should also be noted that costs are higher in the case of the dwarf coconut, as more than twice the number of nuts have to be handled in the process of copra manufacture as compared with the ordinary nut.

"The returns from Sungei Nipah appear to confirm the observations appearing on page 37 of the manual referred to :—

" 'From our observations so far, we incline to the opinion that the King variety will require rather high cultivation in order to obtain satisfactory returns, and may then possibly yield as much as an average of 75 nuts a tree per annum.'

"It seems to me that Mr. Handover's predictions have been formulated in a spirit of enthusiastic optimism, without sufficient available actual results and data, and until such are available a good deal of caution should be exercised by potential investors and the public generally. Mr. Handover has not yet established the equality of the King with the ordinary coconut tree, far less its superiority, and for the comparison with rubber, in normal times, the question does not arise, as they say in another place.

"I have been deeply interested in and connected with coconut cultivation for over fifty years, and it must not be assumed, from what I have written above, that I have any bias against the 'Dwarf' variety, or any wish to thwart a new enterprise or discourage its introduction on a commercial scale in Malaya. Far from it, when Sungei Nipah was being opened up, I took the keenest interest in the experiment, and visited the estate on many occasions with the manager, Mr. Cunningham, and even made special report to the F. M. S. Government. What I feel is, that results have been very disappointing, and that the enterprise is being inflated beyond its merits. The two most important factors in determining the value of the 'Dwarf' cultivation have not yet been ascertained and established definitely. The first is the age at which the tree ceases to be productive ; the other, whether the tree is likely to give average good crops year by year during its productive life. When these points have been satisfactorily established there will be material for the construction of reliable scale of production and profit. It is admitted that individual dwarf coconuts yield prolific crops, and other advantages are very clearly detailed in the book above referred to (page 37), and I still incline to the view that, with high cultivation, this should be a sound and moderately remunerative investment. However, the industry as a commercial proposition is yet in the experimental stage, and until such time as actual figures and data are available, hypothetical estimates and scales of production and profits should be regarded with great caution and reserve.

"At the same time I must say that I appreciate highly the courage of Mr. Handover in experimenting and undertaking the pioneer work for an industry in which, obviously, he has such faith, and trust he will yet have a due measure of success. While I criticize his predictions, I admire his altruism"—*Tropical Life, Volume XXVII, No.* 11.

VI

The Manuring of Coffee Estates.

In the very early days of Coffee planting the short-sighted policy was indulged in of letting estates go years without manure. Since manuring was taken in hand, planters in Mysore and Coorg have depended mainly on bones and poonac for manuring their estates. I cannot speak with any certainty of other districts; but that the practice was fairly general is evident from a letter published in the Press from Mr. John Kenny, late Manager of the Madras Presidency Manure Works, in which he says "Bones and white castor have for years been employed by coffee planters in India as a complete manure." The practice is continued till this day in some cases. A certain amount of farmyard manure (cattle manure and sweepings of cooly lines) is utilized, but the quantity available is not sufficient to apply to more than a portion of the area manured each season, except in a few cases. The acreage manured every year usually varies from one-fourth to one-third of the area. In rare cases half the area of an estate, and in still fewer instances the whole of a place is manured every season.

Cattle are expensive to keep for manurial purposes alone, and a large number of estates do not possess the grazing land necessary. At one time in South Coorg dry cattle droppings and village farmyard manure was largely purchased; but it proved expensive, and the results were probably not deemed commensurate with the expenditure, for the practice was discontinued. All planters are agreed that cattle manure is *par excellence* the best fertiliser for coffee. Possibilities exist for augmenting farmyard manure by making composts of vegetable matter, cattle manure, lime, line sweepings, coffee pulps and soil. Though this is not neglected in some cases, it is not generally carried out to the extent that it might be. Want of labour is a handicap in some places, bulk manure being slow of application, as to obtain the best results it is necessary to apply half a bushel to three trees. This is obviously only sufficient for one season. Jungle top soil and swamp soil are sometimes applied direct to the coffee. The former is of the best, but would be all the better for lime being mixed with it, perhaps at the rate of one of lime to ten

of soil. But it is difficult to get good jungle top soil unless there should be a reserved piece of jungle which it is not intended to open. Ryots in South Coorg at one time sold soil to the estates, but Government stopped this impoverishment of their land. It is more necessary to mix lime with swamp soil, especially if it consists of clay, in order to reduce its elements to a soluble state. Liebig says :—

"The process by which the elements of clay are brought into a soluble state by fire corresponds to that by which they are brought into the same condition by the affection of lime." The weathering action of the atmosphere will act more slowly and the results will not be as thorough and satisfactory as those brought about by the action of lime, and, in the meantime, the presence of the clay, as clay, may be deleterious to the trees.

Fish and "fish guano" are sometimes applied to the coffee direct or are added to a compost, rendering it very rich in all constituents, chiefly nitrogen — but the all-important element of potash is wanting. Fish guano consists of what is left of the fish after the extraction of the oil. Fish manure may be said to be bones and poonac (oil-cake) in another form, for it contains exactly the same plant foods — nitrogen and phosphates — the organic part of the fish supplying the former and its bony structure the latter. Applied alone, it is apt to supply an excess of nitrogen to the soil being practically a nitrogenous manure, as the organic part more readily decomposes and becomes available than do the phosphates. The same happens when bones and poonac are applied. The bone meal is said to persist in the soil for two years, by which time the poonac is all exhausted. Burnt clay has also been applied at times. Applied in sufficient quantity it improves the mechanical condition of the soil, making it more open and friable ; but it has hardly ever been produced to the extent of being useful for mixing with artificial manures to secure the more equable distribution of the latter. Finally leguminous green crops have been grown where the coffee has not been too dense to permit of their successful growth and incorporated with the soil, and that other form of green manuring of growing *Erythrina lithosperma* in the coffee and mulching the soil with its loppings is carried out in some places.

Most of the methods of manuring here enumerated have been the result of innovations gradually introduced, and some of them are the direct result of the Scientific Officer, (the Deputy Director of Agriculture) Mr. Anstead's advice. When manuring was first taken in hand, half inch and one inch bones were largely applied in small holes near the collar

of the trees. In eradicating borer these bones are turned up even to the present day in compact masses cemented together by soil. The late Mr. Pringle, Agricultural Chemist to Messrs. Catheson & Co.'s estates in South Coorg, might well have characterised this as "manuring for posterity." It is appaling to contemplate the amount of money that must have been wasted under the mistaken notion that this method of applying bones was the most approved way of supplying the needs of the trees of plant food.

In all the methods of manuring here noticed, it is to be noted that the plant foods chiefly supplied are nitrogen and phosphates, and in nearly all of them, with the one exception of farmyard manure, the nitrogen is in excess. Farmyard manure is a complete general manure and contains an appreciable amount of potash, which important plant ingredient is notably absent in all the other manures noted. Mr. J. Hughes, the Agricultural Chemist, who came out to report on Ceylon soils and the manures best suited to them when coffee was still extant there, gave it as his opinion that an excess of nitrogen was not necessary to the well-being of coffee ; and the late Mr. Pringle pointed out that an excess of the substance acted deleteriously in making the trees grow a profusion on wood and foliage to the detriment of crop. This has received corroboration from Mr. Anstead, who agreed with Mr. Pringle that the show of blossom was often out of all proportion to the crop harvested, and the reason for this was probably to be found in an excess of nitrogen supplied to the trees.

Mr. John Kenny in his letter to the Press referred to above says : "It is difficult to understand the absence of potash in the mixtures used on coffee plantations," especially as, I may add, in all analyses of coffee soils only traces of potash are shown as existing in them ; and that it is the most important element in the nutrition of coffee is clear from an analysis of the requirements of a yield of 7 cwts., by Mr. John Hughes, referred to above, which showed that the quantity of potash extracted from the soil was nearly double that of the phosphates and more than double that of the nitrogen.

Dr. Voelcker, the eminent Agricultural Chemist, in his analysis of the coffee and tea soil of Southern India showed that they, being of laterite formation, were particularly deficient in phosphoric acid and lime. Lime is another constituent that has not been used as largely as it might have been with the greatest possible benefit. Dr. Voelcker, Messrs. Anstead and Cameron have recommended the application of tons per acre. At one time apprehensions were entertained that lime burnt up

everything in the soil, perhaps because heat is produced when it is slaked, and destroyed its fertility! It would take up too much space to enter upon a discussion of the functions of lime in soil, but it may be pointed out that it is an indispensable ingredient of all fertile soils; and that in Coffee, where there is an excess of vegetable matter supplied by heavy mulchings from shade trees and weeds, and green manure, its application is necessary to bring about its more complete decomposition.

During the War potash was unobtainable owing to the only known source of supply, Germany, being cut off. But Dr. Lehmann, late Agricultural Chemist to the Mysore Government, showed by an analysis that lantana ashes contain as much as 13 per cent of this valuable constituent. It is not necessary to cut lantana before burning it, as there is an accumulation of dry branches under the thickets in the dry season sufficient to raise a conflagration great enough to consume nearly all of them except the roots. I have had opportunities of seeing this tested again and again. And yet this cheap source of potash is not utilized to the extent it might be. I have seen acres of lantana ashes in the vicinity of an estate lying neglected on the score of its being too expensive to merely transport and apply them to the coffee. It is to be noted that in all cases where a complete manure is used the result in crops is more satisfactory, and it may safely be said that the addition of an adequate percentage of potash to manure mixture is more highly appreciated now-a-days and is coming into more general use.

Coffee invariably responds magnificently to liberal treatment. The case of Mr. Mangle's Cover-Kollie estate may be cited in illustration of this. According to the late Mr. R. H. Elliot, the well-known Mysore planter, every acre of this estate used to be manured every season on the following plan. Half the estate received cattle manure at the rate of half a bushel per tree, and the other half artificial manure, and the whole estate a small dose per tree of Nitrate of Soda. The succeeding season the half that received the cattle manure the previous season received artificial manure, and the other half the cattle manure, while the whole estate was given the usual dose of Nitrate of Soda. Mr. Elliot said that the place was the best coffee property he had seen in Southern India (and he had visited a good many). It is 600 acres in extent. I believe, and under the treatment above outlined, it produced an average of 200 tons of crop yearly.—*Indian Scientific Agriculturist. Volume* 3, *No.* 1.

VII

Cashew-nut.

At the present time there are few favoured countries in the world where enough food is found for the inhabitants. The great remainder, comprising of the countries that are called civilized, is crying aloud for more and more production of food. India is no better in this respect than foreign countries. Yet in her jungles and wilderness there are plants capable of yielding highly nutritious food in large quantities, provided sufficient attention is bestowed on their culture and expansion in area. Cashew-nut is one of such plants. Scientifically it is known as *anacardium occidentale* and people in Bengal call it "Hijli Badam". Originally a native of Central and South America, it has now spread over many parts of the globe, *viz.*, India, Indo-China, Malaya Archipelago, Phillipine Islands, West and East Africa, Madagascar and even some parts of Australia. In India its introduction is a little over a couple of centuries old. As in the case of some other economic plants, for Cashew-nut too, we are indebted to the Portuguese for bringing a stranger which has taken very kindly to the country of its adoption. In the Coast forests of India Cashew-nut is a very prominent tree to-day. In Goa, Malabar, Cochin, Madras, Orissa, the seaward portion of the Bengal, of Midnapur, Chittagong and the maritime localities of Burma, Cashew-nut tree is well known to the local people and highly appreciated by them for its many valuable qualities.

The Cashew-nut tree is not captivating to the eye. It has a knotty, twisted, unsymmetrical appearance, owing to its whole life being spent in a struggle against an almost barren sandy soil, heavy monsoon rains, the parching heat of summer and the high winds of the seashore. Generally it is bushy in habit and not more than 20 ft. high, but in sheltered situations individual trees have been found to attain a height of even 50 ft. It does not flourish very well in places considerably distant from the sea as it prefers a saline, or at least brackish soil and water. As found wild in Orissa and the Contai sub-division of the Midnapur district, Cashew-nut is seen to occur in gregarious patches a little behind the sand dunes which characterise the sea face in these localities. The acrid nature of the bark, young twigs and the gum prevent any animal from destroying the tree and thus help the preservation of the species. The trees begin to flower at the end of winter and the nuts mature before the rains. Two varieties, with pinkish and white flowers, are found, but their comparative merits, from the nut-bearing point of view, have not been studied. A species of scale insect has been noticed to do some

damage to the flowering spikes, especially in the Contai sub-division of the Midnapur district. Generally no care is taken of the tree and there is only one regular picking of the nuts during the season. The nuts fallen from the trees are often picked up by the lower classes of people inhabiting the coast and sold in the nearest market places or to the agents or merchants, who visit seaside villages to purchase the article.

Insignificant looking though the Cashew-nut tree may be, it is nevertheless a valuable tree. There are at least half a dozen purposes for which it may be utilized. The wood is an important source of fuel and hut-building material to the people of the Indian Coasts. The gum exuded by the tree is a prevention against attacks of insects and its effect is greatly heightened when applied in the form of a solution mixed with asafœtida and aloe. There is pretty large demand for it in the United States of America. The bark is a tanstuff and the juice of it may be used for the same purposes as the marking nut, the stain produced being equally indelible. The peculiarly formed fruit, however, is the most important part of the plant. The stalk or thalamus of the fruit is much swollen and pear-shaped, and the fruit proper, kidney-shaped and about 1 inch long, is attached to the end of it. This stalk when ripe is sweetish to the taste, although slightly acrid and is eaten cooked and raw by the people in Cashew-nut areas. As a possible source of sugar it has never been investigated, but in Goa a sort of arrack is prepared from the stalks which at one time was much in vogue among the Goanese. The fruit has a dark coloured, thick outer covering or shell and inner whitish kernel. The shell constitutes about 30 per cent of the weight of the fruit and yields an oil which contains cardole and anacardic acid in about 10 per cent and 90 per cent respectively. Cardole is vesicant and possesses insecticidal properties in a high degree for which it is much valued by book-binders and men interested in the preservation of timber. The shell oil mixed with charred coir yields a good varnish and is largely utilized in colouring boots, fishing nets and tackles. The kernel, slightly roasted, is as delicious to eat as real almonds and, besides being used separately, is considerably employed by Indian confectioners in preparing high grade sweetmeats.

It may not be generally known but it is a fact that the kernel oil of Cashew-nut is superior to olive and equal to sweet almond oil in its properties. The oil percentage is so high as the following table taken from a paper published by the Imperial Institute of London sometime ago, shows the comparative values of the Cashew-nut and sweet almond kernel oils:—

	Cashewnut.	Sweet Almond.
Water	16.01	6.0
Protein	18.00	24.0
Fat	57.38	54.0
Carbohydrates ..	5.28	10.0
Fibre	0.91	3.0
Ash	2.42	3.0
Food units	194	205
Nutrient ratio ..	1:7.63	1:5.59

The nutritive properties of Cashewnut kernels are undisputed. Yet the plant producing these has not received a fraction of the attention that it deserves.

In India the collection and marketing of the Cashewnut are still in the hands of people, who understand very little about the virtues of clean methods and much less about the damage done to the nutritive qualities of the kernels by indifferent shelling and stocking.

Nuts after picking are spread out in the sun in thoroughly open places to dry. This takes three or four days in fair weather. The fruits are then sold in three conditions, *viz.*, (1) dried nuts from which the shell oil has not been extracted ; (2) nuts free of shell oil ; and (3) shelled nuts, *i.e.*, kernels only. Fruits under the first condition are brought to the market by women and children of the lower classes of people who pick up the fallen fruits casually, while shell-oil-extracted nuts are available only from small zemindars. For extracting oil from the shell a sort of covered sand bath of a very primitive design made of earthen pots is used. The vapour of the shell oil being very injurious to the face and eye, people generally try to finish the operation quickly and employ an amount of heat at a time that is injudicious and that affects the kernels in an injurious way by decreasing their flavour and albumen constituents to a considerable extent.

Cashewnuts were formerly cheap at the centres of their production, being sold at about Rs. 6 to 7 per maund. But the price has nearly doubled now, the average being nearly Rs. 12 per maund. It also appears that neglect in the extension of areas, destruction of nut bearing trees and impoverishment of soil have all combined to produce a considerably smaller outturn than of yore. For instance, in the Contai sub-division of the Midnapur district, it is not possible now to get more than 50,000 maunds of nuts a year when nearly double that quantity was available before The kernels generally fetch a price amounting to twice that of

the entire nuts, but the rate is liable to much fluctuation according to the season of the year.

For export trade entire nuts are rarely used, kernels being preferred by foreign buyers. Cases of 2 cwts. each are the units of sale in the foreign countries and the average price of 1 cwt. of kernels is about 60 shillings or 70 shillings in the case of blanched kernels. Bombay is by far the most important port for foreign trade in kernels. It is a pity, however, that any portion of the annual output of such a highly nutritive material should go out of the country when there is so much scarcity of food in India itself.

The main drawback about Cashewnut is that it is so little known to the average people outside the zone of its actual production. Cashewnut areas may be greatly extended without prejudice to any other plant of economic interest. In fact it grows in soils and situations which are not suitable for any agricultural crop. Next to the extension of area the importance of the proper methods of preparing the nuts for the market should be appreciated. There is so much dearth of good edible oils in the market just now that Cashewnut kernel oil would sell at highly remunerative prices if carefully prepared. It is very necessary to disseminate knowledge about the habitat, natural and artificial propagation and the proper treatment of the economic products yielded by the Cashewnut among the people. In this work the Agricultural and Forest Departments may render a good deal of help. In short, the Cashewnut being such a prolific source of good food and being so easy to grow, it should never be neglected, but every endeavour should be made to increase the area under it and to utilize all the valuable economic products derivable from this tree. *Indian Scientific Agriculturist, Volume* 3, *No.* 1.

VIII

Science and Crop Production.

(*Continued from our last issue.*)

This experiment ought to be repeated in many districts, for it is by no means certain that farmers generally are using the most profitable quantities of fertilizer at the most effective time. It is, however, necessary to take into account something more than the quantity and the time of application of the fertilizer. It is essential also to have a suitable mixture. In the old days this question was thought to be fairly simple. Chemists used to think that, if they knew the composition of the ash of plants, they would know what manure to use; it should supply all the ash constituents in the quantities present in the plant. This is

now known to be wrong; the composition of the ash affords no guidance to manurial requirements, as was, indeed, shown by Lawes and Gilbert in 1847. The distinguished French chemist, Georges Ville, emphasised the fact that only properly conducted field trials would ever settle the question. Vast numbers of such experiments have been made, and they show that the problem is more complex than Ville thought. It is now known that no single formula expresses the fertilizer needs of a crop; every district, almost every farm, has its own special requirements.

Still further difficulty is introduced by the fact that the various artificial fertilizers not only increase crop yields, but also influence the composition and habit of growth of the crop. Nitrogenous manures tend to a vegetative growth of large, deep-green leaves which are somewhat liable to be attacked by fungoid pests. Phosphates improve root development, and are therefore of special value for swedes and turnips; they also hasten ripening of grain, and are therefore particularly useful in late districts; they increase the feeding value of crops, and are therefore useful for fodder crops; and they have a remarkable effect on the development of clover, which is not yet fully understood, but which has revolutionised the treatment of pastures in this country. Potassic fertilizers improve the vigour of the plant and increase its power to resist fungus attacks. These and other special properties of fertilizers are now well established, and advantage is taken of them in drawing up fertilizer schemes to suit the special requirements of each farm.

It has already been pointed out that this work on artificial fertilizers arose out of Lawes and Gilbert's discovery that the wheat crop of 1843 grew just as well when supplied with the ash constituents plus combined nitrogen as when supplied with farmyard manure. They repeated the experiment year after year; periodically the results were collected, and even after fifty years on an average the artificials had done as well as the farmyard manure. In consequence of this and other experiments many agricultural chemists developed the view that artificial manures were at least as good as farmyard manure for ordinary use on the farm; but wider knowledge has shown that this is not the case; it is only a first approximation to say that artificial fertilizers are equally as good as farmyard manure; we now know that farmyard manure produces effects of the highest importance to the land which no known combination of artificial fertilizers will bring about.

Examination of the Broadbalk data in the statistical laboratory recently instituted at Rothamsted under Mr. R. A. Fisher shows farmyard manure differs in two ways from artificials — the variation in yield

from year to year is diminished by the use of farmyard manure, as is also the deterioration in fertility due to continuous cropping for eighty years. No fewer than fifteen different combinations of fertilizers are tested against farmyard manure, and while some of them come out quite well on an average of twenty-five or fifty years, they fluctuate considerably from season to season, and they show manifest signs of deterioration as the years pass by. Many farmers prefer a steady yield to a fluctuating one, and this, of course, is sound, cautious business. Farmyard manure never does badly even in the worst seasons, but on the other hand, it does not give record crops even in the best seasons. What we should like would be something possessing the special values of farmyard manure in bad seasons, and of the artificials in good ones.

Further, there is a deterioration of yield on all our plots (No. 2708, Vol. 108) treated with artificials excepting perhaps those receiving exceptionally high dressings. This is shown on both the wheat and the barley plots, and it is greatest on those plots where one of the essential fertilizer constituents is withheld (Fig. 2).

There is a third effect, which is very marked in rotations. Farmyard manure appears to have a greater effect than artificials in increasing the growth of clover. Unfortunately the number of experiments is not very great, but, so far as they go, they show a striking superiority over artificials, and this extends not only to the clover, but also to the succeeding wheat crop.

The results of Rothamsted are :—

	Yield of clover hay Cwts. per acre	Yielding of succeeding wheat crop	
		Grain Bushels per acre	Straw Cwts. per acre
Manure applied to previous corn crop :—			
Farmyard Manure ..	62	45	45·3
Artificials only.. ..	46	37	36·8

At present we cannot explain all these remarkable facts. There are several possibilities :—

(1) Farmyard manure is known to exercise remarkable physical effects on the soil, causing it to become puffed up so that the empty pore spaces increase in size. The air supply to the roots thus becomes better, the water supply is more evenly regulated, the work of the tillage implements is lightened, and a good tilth is more easily obtained. The

difference is well shown by the root crops —swedes, turnips, and particularly mangolds, which are very sensitive to soil conditions, and, being sown late, are liable to suffer from spring and summer droughts. The plots at Rothamsted always have some 2—5 per cent more moisture than those receiving no manure or artificials only, and this enables the mangold to keep growing during a drought which effectually checks all plants not receiving manure.

(2) It is possible that there are chemical constituents in farmyard manure which are not present in our artificial fertilizers. The old idea that nitrates, potash, and phosphates only are necessary may be wrong. Recent work by Maze in Paris and by Dr. Winifred Brenchley at Rothamsted shows that some of the other elements may also be helpful. In the Rothamsted experiments very small quantities of boric acid added to the soil caused distinct increase in crops fully fertilized with artificial manures. We cannot as yet recommend farmers to adopt this kind of manuring with special substances, because it is to the crop, for the plant suffers seriously from even slight excess. With fuller knowledge, however, it may prove possible to keep this special manuring within bounds.

(3) In the case of the clover crop the farmyard manure or the straw in the litter may have a special effect on the organisms living in the root, causing them to increase the amount of nitrogen fixation and thus give larger clover crops and further enrich the soil in nitrogenous organic matter.

Work on these problems is progressing; the scientific investigator has, of course, to find out exactly what is happening before he can show the practical man how to exercise control.

But in the meantime it is necessary for us to be practical and to do something, and the most obvious line of action is to increase the amount of farmyard manure or similar substances on the farm. We can proceed in two ways; first, wastage can be cut down. We estimate that the farmers of the United Kingdom make about forty million tons of farmyard manure a year, and waste about ten million tons. We have shown that the best results are obtained when manure is made under cover and the amount of litter properly adjusted to the amount of nitrogen in the animal excretions. Correct adjustment is a counsel of perfection, but a great improvement is possible over the present haphazard methods. In practice nitrogen is always lost through exposure to weather, greatly to the detriment of the manure. The provision of some shelter for the heap is not difficult, and, as Prof. Berry has shown at Glasgow, it is distinctly advantageous.

Another method is to increase greatly the amount of farmyard manure or similar substances produced on the farm. This could be done by running on more animals. The number of livestock per acre could be much increased by the general adoption of the methods of some of the Scottish and Danish farmers, who keep their animals largely on the produce of their arable land. The problem is closely bound up with financial considerations, but the experiments of Mr. J. C. Brown at the Harper Adams Agricultural College show that more profit is obtainable from the soiling system than from the older methods of the south.

At Rothamsted we are examining possible substitutes for farmyard manure, green manuring, and the activated sludge method of producing manure from sewage, both of which seem quite promising. We tried using straw as manure, but without success; so soon, however, as the straw was rooted, much more promising results were obtained. The conditions for the proper rotting of straw, investigated at Rothamsted by Dr. H. B. Hutchinson and Mr. E. H. Richards, were found to be proper air and moisture supply, suitable temperature, freedom from acidity, and the proper proportion of soluble nitrogen compounds. All these conditions are easily obtainable on the farm, and it is now possible to make an artificial farmyard manure from straw without the intervention of animals. So far the results seem quite satisfactory (No. 2708, Vol. 108.) Arrangements are being made for demonstrations on an extensive scale during the present season.

All these problems I have been discussing represent work of interest to the present generation of farmers; but the scientific investigator cannot be restricted to problems of present-day interest. Some of the best work of to-day may never reach the farmer in our time, and, indeed, unless it is developed, it will never reach the farm at all. We now know that the farmyard manure and the green manure put into the soil are not really agents of fertility, but only raw materials out of which fertility is manufactured. The work is done by myriads of living creatures in the soil, which are too small to be seen by the naked eye, and only incompletely revealed even by powerful microscopes. Some of them are useful to the farmer and some not, many of them taking their toll of the valuable plant food in the soil. Their activity fluctuates daily, almost hourly, and their numbers are counted and their work is watched in our laboratories. Much of their activity is helpful to the farmer; it makes nitrates, indispensable for the growth of plants. Much of their time, however, is spent in undoing the good work they have done, and results in the destruction of a large proportion of the nitrates made. We are

studying this population, and with fuller knowledge we hope to control it and make it serve the farmer just as horses, sheep, and cattle do ; but we are a long way from that yet.

Finally an attack is being made on a much more difficult problem. The growth of a crop is like the movement of a motor-car ; it cannot go on without a continuous supply of energy from the petrol ; in the case of the growing crop it comes from sunlight. The plant, as we grow it, however, is not a very efficient transformer ; a crop of wheat utilizes only about half of 1 per cent of the energy that reaches it. During the last eighty years the growth of crops has been improved, thus increasing their efficiency as utilizers of energy ; but we are still a very long way from the 30 per cent. Better developments of our present methods will no doubt carry us further than we have yet gone, but some wholly fresh ideas are necessary before we can hope to bridge the enormous gap that now exists between the actual and what is theoretically possible. There seem to be at least six ways in which we might improve crop production :—

(1) We can hope for further improvements by the use of new varieties capable of making better growth than those ordinarily cultivated. Plant breeders all over the world are attacking this problem with much success, and many of the new sorts show considerable promise.

(2) Much can be done by control of plant diseases. Unfortunately we have no means of knowing how much is lost each year by pests or disease, but it is undoubtedly considerable. Laboratories for studying plant pathology have been set up at Rothamsted and elsewhere, and we are hoping to achieve good results ; much valuable information has already been obtained.

(3) We are also looking to the tractor to achieve great things on the farm. It will allow considerable development of cultivation implements, enable us to improve our tillage and to keep down weeds, a very serious trouble in the southern part of England. Good Scottish farmers in that region have told me that farming in Scotland is much easier than in England, because the rigorous northern winters keep weeds in check, while the mild southern winters encourage their growth.

(4) It is possible that certain substances, such as boric acid, the fluorides, etc., studied by Gautier and Claussmann in France, may help in raising crop growth.

(5) It is possible also that special methods may prove of value, such as the high-tension discharge tested by Miss Dudgeon at Lincluden, Dumfries, and ably and critically studied by Prof. V. H. Blackman.

(6) Finally, it seems probable that some wholly new method may be found for increasing crop growth. In most civilized countries there are now research institutes where the ways of plants and the properties of soils are being studied. Men of science, as a rule, do not care to risk prophecies or to attempt to create sensations, and I certainly am not going to break this wholesome rule. Something, however, has already been done ; in spite of the decreased labour spent on cultivation, the yields tend to go up, while the new knowledge that is now being gained is adding greatly to the pleasure of farming and giving both masters and men an interest in their work that they never had before.—*Nature, Volume* 108, *No.* 2708, *pages* 116 *to* 120.

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